A LESSON ON ADAPTATION

LOOKING AT THE BARREL CACTUS

As part of the National Park Service, Chamizal National Memorial is charged with protecting and preserving natural resources living within the park's boundary. One such species is the desert native Barrel Cactus.

Objectives:
Students will be able:

- List the different physical features of a barrel cactus.
- Describe how these physical features help it live in a desert environment.
- Draw or construct a model of a barrel cactus.

Background Information:
The scientific name for a barrel cactus is *Ferocactus*, which translates as "fierce or wild" cactus. The plants are generally cylindrical or barrel shaped and are usually among the largest cacti found in North American deserts. Members of this genus have prominent ribs and are covered with heavy spines or needles. In some species, one or more central needles are curved like a fishhook, accounting for the common name Fishhook Barrel Cactus.

Most barrel cacti are round and green. The needles can be red, violet, or yellow. These stout ribbed plants can reach heights up to 10 feet high. When fully hydrated, a cactus can be 90-94% water, to last months or years until the next soaking rains. Even a small barrel cactus can weigh hundreds of pounds because of the water it can hold.

Most barrel cactus have 1-1/2 to 2-1/2 inch yellow-green or red flowers growing in a crown near the top of the stem. They bear no spines and only a few scales. Fruits become fleshy and often juicy when mature, but are not usually considered edible. Native Americans boiled young flowers in water to eat like cabbage and mashed older boiled flowers for a drink. They also used the cactus as a cooking pot by cutting off the top, scooping out the pulp and inserting hot stones together with food. The spines were used as needles, awls and in tattooing. Soldiers and explorers claimed they could survive in the desert by drinking the liquid from the barrel cactus. In truth, the pulp fiber is full of

LESSON LENGTH:
2 45- to 55-minute classroom sessions

MATERIALS:

- Pencils
- Writing & Drawing Paper
- Color Pencils, Markers, etc
- Modeling Clay *(optional)*
- Construction Paper
- Glue
- Small, potted barrel cactus
- Knife

TEXAS ESSENTIAL KNOWLEDGE & SKILLS

Language Arts & Reading TEKS
3.1, 4.1, 5.1 (A) determine the purposes for listening such as to gain information, to solve problems, or to enjoy and appreciate;

4.1, 5.1 (B) eliminate barriers to effective listening;

4.2, 5.2 (D) monitor his/her own understanding of the spoken message and seek clarification as needed;

Science TEKS
2.9 (A) identify the external characteristics of different kinds of plants and animals that allow their needs to be met;

3.3, 4.3, 5.3 (C) represent the natural world using models and

identify their limitations;

3.8 (C) describe environmental changes in which some organisms would thrive, become ill, or perish;

3.9 (A) observe and identify characteristics among species that allow each to survive and reproduce;

4.8, 5.9 (A) compare the adaptive characteristics of species that improve their ability to survive and reproduce in an ecosystem;

4.8, 5.9 (B) analyze and describe adaptive characteristics of species that result in an organism's unique niche in an ecosystem;

Social Studies TEKS
4.7, 5.7 (B) describe a variety of regions in (Texas and the Western Hemisphere and/or) the United States such as landform, climate and vegetation regions that result from physical characteristics.

Extensions for Independent or Small Group Learning:
Have students speculate possible reasons why barrel cacti were once plentiful but now are a rare species. Large, mature barrel cacti were over-harvested because of the candy making industry during the 1900s. In addition, the popularity of desert landscaping created a huge market for large barrel cacti. Their slow growth has made it nearly impossible to replenish the plants that were once in abundance in their natural habitat.

Have students research how alkali which makes the liquid unfit to drink.

The pulp of barrel cactus has been widely used for making cactus candy (thus one of its common names, Candy Barrel Cactus), but this has also accounted for its destruction and, therefore, protected status in many areas.

Sources: National Park Service www.nps.gov & Desert USA www.desertusa.com/mag99/june/papr/barrelcactus.html

Before Class Preparation:
Carefully remove needles and flower buds from a small barrel cactus bought from a local garden shop. Cut the fleshy arms of the cactus into small pieces. Distribute these individual pieces as examples to the class while you speak about each physical characteristic. Do not show the class the entire barrel cactus, just the individual pieces.

Class Discussion:
Introduce the lesson by asking students to list what they know about deserts and what types of plant life can live in such an environment. Write student comments in front of the class.

Ask the class if anyone has ever seen a barrel cactus. Have students guess what it may look like by just its name (barrel = a cylindrical, pudgy object; and cactus = a thorny, harsh looking plant).

Class Instruction:
Describe to students some of the barrel cactus' features that it has developed to thrive in an arid climate. Ask students why they think each particular feature would be important to a plant living in the desert. Have students take down notes so that they can refer to this information at a later time.

- Accordion-type ribs with waxy outer coating instead of branches (the waxiness helps the plant retain water and the ribs decrease the amount of surface area exposed to the desert climate)
- Sharp, hooked needles instead of leaves (the abundant needles provide shade from the harsh sun, and protect against hungry and thirsty desert animal life)

- Expanding and contracting sponge-like body to store water (the body swells to store as much water as possible when it rains and contracts as it uses up its water supply). *You may want to fold a sheet of paper accordion-style to demonstrate how the plant expands and contracts.*

- Mesh netting of roots near the ground surface instead of those that grow thick and deep into the ground (the roots' netting helps the plant soak up rain as soon as it falls).
- Smaller surface pores that close during the day and open at night (this helps the plant reduce *transpiration*, i.e., the evaporation of water into the atmosphere from the leaves and stems of plants).
- Brightly colored fruit blossoms (small animals and birds eat the fruit and later deposit the cacti seeds in other nearby areas to grow new barrel cacti).

Without showing students a photograph of a barrel cactus, have students draw or construct a model of what they think this type of cactus would look like just by the description of its physical adaptations for desert living. Have students label each of the parts of the cactus and how it helps the plant thrive in a desert environment. Display student work in a public area.

Wrap-Up Discussion: Barrel cacti are a rare species of plant life. They can take decades to reach their full size. The number of mature barrel cactus is extremely limited because of over-harvesting and illegal poaching on protected lands. As a class discuss the National Park Service's role in preservation of native plant life within a park's boundary.

Assessment: see following handouts

Have students complete the Barrel Cactus Worksheet.

Use the rubric to evaluate student understanding of the characteristic features of a barrel cactus adapted to the desert environment.

Native groups have used these cacti in the past (candy from the plant pulp, boiled new flowers to be eaten like cabbage, created a drink from mashed older flower buds, as a cooking pot once the pulp was emptied, and needles as fish hooks as well as for sewing and tattooing purposes). *Recipes using prickly pears (a cousin to the barrel cactus) can be found on the internet; having students follow the recipes will reinforce Math concepts and skills. Be sure to follow all safety instructions when handling and preparing the cactus.*

Chamizal National Memorial cares for about 10 barrel cacti throughout the park's 55-acres. Most of these cacti are younger than 10 years old. However, there is a small cluster of these plants at the front entrance of the park that are more than 100 years old and stand about 5-feet high.

Student Name _____ Date _____

Looking at the Barrel Cactus Worksheet

Match the parts of the cactus with the letter that describes its physical adaptation purpose.

____	Waxy Outer Coating	**A.**	Allows the plant to grow large enough to store substantial amounts of water.
____	Accordion-style spines	**B.**	Attract small animals and birds, which eat the fruit and then deposit the seeds in a nearby location.
____	Sharp, hooked needles	**C.**	This protective layer helps the plant retain water.
____	Sponge-like body	**D.**	These help the plant reduce transpiration by closing during the heat of the day and opening only during the cool evening hours.
____	Mesh netting of roots	**E.**	Helps plants soak up the most amount of rain as soon as it falls.
____	Fruit Blossoms	**F.**	Helps decrease the amount of surface area exposed to the arid desert climate
____	Small surface pores	**G.**	Provide shade to the plant as well as help protect it from thirsty animals.

Fill in the Blank

Often mistaken for a young saguaro cactus, the _____ cactus only grows to about five feet tall. Despite their size and appearance, the barrel cactus can weigh hundreds of _____. The barrel cactus is full of pulp fiber which holds large amounts of _____. Its _____ form a kind of mesh net, reaching out across the desert floor. These help the cactus soak up rain as soon as it falls. Accordion-like folds on the cactus help it to store as much water as possible. The _____ on the barrel cactus not only protect it from the sun and thirsty animals, they were once used by Native _____ as fish hooks.

Looking at the Barrel Cactus Rubric

Student Name _____ Class _____

Category	Mastery – 4 (25 pts each)	Proficient – 3 (20 pts each)	Adequate – 2 (15 pts each)	Needs Improvement – 1 (10 pts each)
Diagram/ Model Skills, data analysis and recording summarization	Exhibits exceptional diagram/model making skills by correctly incorporating and identifying all characteristics talked about in class discussions	Exhibits proficient diagram/model making skills by correctly incorporating and identifying most characteristics talked about in class discussions	Exhibits adequate diagram/model making skills by correctly incorporating and identifying some characteristics talked about in class discussions	Exhibits poor diagram/model making skills by correctly incorporating and identifying few characteristics talked about in class discussions
Skillful use of media	Exhibits exceptional skills in use of media and techniques used in diagram/model making. *Well organized diagram/model, use of plentiful, appropriate colors, easy to comprehend*	Exhibits proficient skills in use of media and techniques used in diagram/model making. *Well organized diagram/ model, neat final product, appropriate use of color, easy to comprehend*	Exhibits adequate skills in use of media and techniques used in diagram/model making. *Neat final product, some use of color, some-what easy to comprehend*	Exhibits poor skills in use of media and techniques used in diagram/model making. *Poorly organized diagram/ model, limited use of color, hard to comprehend*
Participation	Exhibits extraordinary conversational skills and generously contributes to group discussion	Exhibits proficient conversational skills and frequently contributes to group discussions	Exhibits adequate conversational skills and occasionally contributes to group discussions	Exhibits less than average conversational skills and seldom contributes to group discussion
Total Points				